



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/811,566	03/29/2004	Jerome J. Cartmell	EMS-07501	1387
52427 7590 03/21/2007 MUIRHEAD AND SATURNELLI, LLC 200 FRIBERG PARKWAY, SUITE 1001 WESTBOROUGH, MA 01581			EXAMINER VERBRUGGE, KEVIN	
			ART UNIT	PAPER NUMBER
			2189	
SHORTENED STATUTORY PERIOD OF RESPONSE		MAIL DATE	DELIVERY MODE	
3 MONTHS		03/21/2007	PAPER	

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No. 10/811,566	Applicant(s) CARTMELL ET AL.	
	Examiner Kevin Verbrugge	Art Unit 2189	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 08 January 2007 and 12 February 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1,3-10,12-15 and 17-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 3-10, 12-15, and 17-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 1/8/07 has been entered.

Response to Amendment

This final Office action is in response to the amendment received 1/8/07. Claims 1, 3-10, 12-15, and 17-20 are pending. Applicants' arguments have been considered but are not persuasive, therefore the art rejection is repeated and made final. All rejections and objections not repeated below are withdrawn.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1, 10, and 15 are rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,761,705 to DeKoning et al.

DeKoning shows the claimed data storage device as RAID storage subsystem 100 in Fig. 1.

He shows the claimed plurality of disk drives as disk drives 110.

He shows the claimed internal volatile memory as cache memory 116.1 and 116.2 and teaches in several places that the cache memories include volatile and non-volatile portions (see column 8, lines 5-22, column 9, lines 53-58, and column 11, lines 23-26 and lines 49-51).

Finally, he shows the claimed directors as redundant disk array controllers (RDACs) 118.1 and 118.2. The RDACs perform the claimed operations as taught throughout the specification and summarized at column 2, line 30 through column 3, line 58 and as further described in the Response to Arguments section below.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 3-9, 12-14, and 17-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 5,761,705 to DeKoning et al.

DeKoning does not explicitly teach locking or testing the memory, however, these are standard memory operations and it would have been obvious to one of ordinary skill in the art at the time the invention was made to include them in DeKoning's device. Locking a portion of memory to prevent additional access to that portion of memory ensures that no changes will be made to memory to interfere with the current write that is being performed, thereby ensuring data accuracy. Testing a memory before using it reduces the chance of failures during use since a memory that fails testing can be flagged and replaced before being put into use.

Response to Arguments

Applicants essentially have only one argument, namely that DeKoning does not teach or suggest the newly added limitations of claims 1, 10, and 15 (see page 12, first full paragraph).

As background, a few relevant passages of DeKoning will be quoted here (emphasis added) so that the clear teachings of DeKoning can be discussed in detail below:

The methods of the present invention then coordinates [sic] the "late check-in" of the second controller by assuring consistency of the redundant caches during processing of host computer I/O request by the first controller. (column 2, lines 45-49)

If one of the control modules indicates a foreign status or indicates an invalid cache due to a "bad" battery subsystem, then the first control module continues to perform host computer I/O requests in a "write-through" mode until the two cache memory modules are again restored to synchronization. The caches are synchronized by appropriate copy operations in the background as host

Art Unit: 2189

computer I/O requests are processed by the first controller in the write-through mode. (column 3, lines 17-25)

After the brief timeout, the first controller will switch to a "write-through" mode of operation as it awaits the "late check-in" of the second controller. This feature of the present invention enables the RAID subsystem to process host computer I/O requests (though in a degraded mode of operation) while the redundant pair of control modules synchronize their respective caches. (column 3, lines 33-40)

It is a further object of the present invention to provide methods and associated apparatus for synchronizing redundant pairs of cached control modules while a first control module of each pair continues to process host computer I/O requests. (column 3, lines 51-55)

The present invention comprises methods, expressed as state machines operable within each of the pair of RDACs, which assure synchronization of the redundant cache memories while reducing the initialization time during which the RAID subsystem is unavailable for processing of host computer system I/O requests. (column 6, lines 62-67)

In the write-through cache mode all write I/O requests are immediately posted to the disk array 108 of the RAID subsystem. (column 9, lines 32-34)

Once the coherency flag is cleared, processing continues with elements 434 and 436 to process I/O requests in the write-through mode while awaiting late check in of the alternate RDAC 118.2. In particular, element 434 processes any outstanding write requests and posts them directly to the disk array writing through the cache 116.1. (column 10, lines 25-30)

If element 606 determines that the cache 116.2 of the second RDAC 118.2 is usable or if element 610 determines that the copy of the cache from the alternate (first) RDAC 118.1 was successful (thereby synchronizing the redundant caches), then processing continues with element 616 to complete processing to synchronize the duplicate, redundant caches. In particular, element 616 is operable to recovery [sic] all volatile cache management data structures (e.g., CCBs) from the non-volatile portion of the cache 116.2 now synchronized with the alternate (first) cache 116.1. Processing then continue [sic] with element 614, as above, to commence processing of I/O requests in the write-back mirrored cache mode. (column 11, lines 43-56)

From this last passage and the rest of DeKoning's disclosure, it is clear that DeKoning's device normally operates in a write-back mirrored cache mode, which is to say that data written to cache 116.1 is mirrored in cache 116.2 immediately and this data is written in disk array 108 later (written back to disk). This is in contrast to the degraded mode of operation when there has been a failure of cache 116.2, for example, and cache 116.1 switches to write-through mode.

Write-through mode is where write requests are posted to the disk array and at least one cache at the same time. This is the normal meaning of write-through mode in the art and although the column 9 passage cited above only mentions that data is posted to the disk array, DeKoning clearly teaches in the column 10 passage cited above that the data is written to the disk array and cache 116.1.

Therefore, in what DeKoning calls the degraded mode, data is written through (and into) cache 116.1 and into disk array 108 until cache 116.2 gets repaired or replaced and is suitable for data storage. At that time, "the first control module continues to perform host computer I/O requests in a 'write-through' mode until the two cache memory modules are again restored to synchronization. The caches are synchronized by appropriate copy operations in the background as host computer I/O requests are processed by the first controller in the write-through mode" (emphasis added, column 3, lines 17-25).

In other words, once cache 116.2 is available again, data from cache 116.1 are copied to cache 116.2 in background copy operations. During these background copy operations, cache 116.1 responds to the host computer I/O requests in a write-through

mode so that any writes are immediately stored in the cache and the disk array, providing security against data loss from the volatile cache 116.1, should it fail. Reads are provided from cache 116.1 as they normally are.

Once cache 116.1 completes the copying of its data to cache 116.2, normal write-back mirroring mode operation can resume since data protection is provided by the caches containing identical copies of the data. If one cache fails, the other cache still has the data.

Specifically regarding the claim language (of claim 1, for simplicity, but relevant to claims 10 and 15 as well), cache 116.1 is the non-faulting memory of the claims while cache 116.2 is the faulting memory.

Initially, cache 116.1 services all host computer I/O requests as claimed since cache 116.2 has faulted.

DeKoning's device determines that cache 116.2 hardware has been replaced as claimed.

Once this occurs, DeKoning's device causes data to be copied from cache 116.1 to cache 116.2 while data is being read from and written to cache 116.1 as claimed (that is why DeKoning calls these "background" copy operations).

In response to a write being performed to cache 116.1 while data is being copied to cache 116.2, this write is performed to cache 116.1 and to cache 116.2 as claimed. It is not clear from DeKoning's disclosure whether this write is performed to cache 116.2 immediately or later as part of the background copy operations, but both alternatives

meet the broad language of the claims. In other words, even if DeKoning's device does not perform this write to cache 116.2 until later as part of the background copy operations, his device is still "causing the write to be performed to the non-faulting memory and the new memory" as claimed.

Finally, once the background copy operations are completed, the system is put in the write-back mirroring mode and all new writes are performed to both caches as claimed.

From Applicant's arguments at the bottom of page 12, it appears that Applicant is attempting to distinguish between the claimed invention and DeKoning's device, which begins mirroring operations after synchronization of the caches is complete. However, a close reading of the amended claims reveals that they do not require mirroring operations to begin before copy/synchronization operations have completed, but rather they require only that a write to the non-faulting memory during copy operations be performed to the new memory before copy operations have completed. Nothing in the claims precludes the situation of DeKoning's device where a write to the non-faulting memory is written to the new memory as part of the copy operations. Then, when all copy operations have completed, mirroring operation can begin (where data is immediately written to both caches simultaneously).

The new claim limitations are met as follows: the time while data is being copied from the non-faulting memory to the new memory is the entire time from when copying begins (shortly after the new cache is inserted) to when copying ends and mirroring

begins. Copying doesn't end until all data in cache 116.1 has been copied to cache 116.2 (to create an identical cache which then can remain identical due to mirroring operations). Copying of the data isn't complete until every piece of data has been transferred, including data which is newly stored in cache 116.1 by the host while copy operations are going on. In other words, the key feature of DeKoning's device is that it permits the host to access cache 116.1 in a write-through mode while copy/synchronization operations are ongoing. That way, the host can store new data in cache 116.1 while data previously stored in cache 116.1 is copied to cache 116.2.

It can be easily seen then, that any new data stored in cache 116.1 while copy operations were occurring must also be copied to cache 116.2 before the two caches can be declared identical and mirroring can begin. Since many data can be written in the cache 116.1 during copy operations and even more data can be written in cache 116.1 while the last "new" data is being copied to cache 116.2, it can be said that copy operations continue after a particular piece of data is copied to cache 116.2 and indeed the only way for copying to complete is for all data in cache 116.1 to be successfully copied to cache 116.2 and not have any more new data written to cache 116.1 during the last copy operation. Only at that point can mirroring begin.

It is easy to see how one of the writes to cache 116.1 occurs during copy operations and is written to cache 116.2 in a later copy operation and is perhaps even followed by a later copy operation of some data that is written into cache 116.1 while this data is written into cache 116.2. This easily meets the newly added limitations.

Art Unit: 2189

The claims do not require the "new" data to be written to caches 116.1 and 116.2 as part of a mirroring operation as Applicant seems to imply in the arguments on page 12.

Conclusion

All claims are drawn to the same invention claimed in the application prior to the entry of the submission under 37 CFR 1.114 and could have been finally rejected on the grounds and art of record in the next Office action if they had been entered in the application prior to entry under 37 CFR 1.114. Accordingly, **THIS ACTION IS MADE FINAL** even though it is a first action after the filing of a request for continued examination and the submission under 37 CFR 1.114. See MPEP § 706.07(b). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

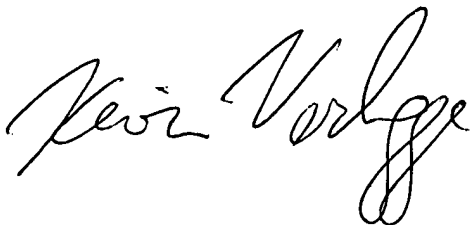
A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

The method claims are grouped and rejected with the apparatus claims because the steps of the method are met by the disclosure of the apparatus and methods of the reference(s) as discussed above.

Any inquiry concerning this Office action should be directed to the Examiner by phone at (571) 272-4214.

Any response to this Office action should be labeled appropriately (including serial number, Art Unit 2189, and type of response) and mailed to Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, hand-carried or delivered to the Customer Service Window at the Randolph Building, 401 Dulany Street, Alexandria, VA 22313, or faxed to (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197.

A handwritten signature in black ink, appearing to read "Kevin Verbrugge". The signature is fluid and cursive, with the first name "Kevin" and last name "Verbrugge" clearly distinguishable.

Kevin Verbrugge
Primary Examiner
Art Unit 2189